production of beats in the ear between pure tones depends on the interval:—

(Ellis's "Helmholtz," p. 260.) "On the other hand we have seen that distinctness of beating and the roughness of the combined sounds do not depend solely on the number of beats. For if we could disregard their magnitudes all the following intervals, which by calculation should have 33 beats, would be equally rough:—

"The semitone	b' c''
,, whole tones	c' d' and d' e'
,, minor third	e g
,, major third	c e
,, fourth	G c
,, fifth	C G
(to which we may add the octave	C_1 C).

"and yet we find that the deeper intervals are more and more free from roughness."

Helmholtz then proceeds to give an approximate determination of this important law, for which we must refer to his work. Our own impression is that this law is almost solely concerned in the variation of the roughness of different combinations. We ourselves hear the roughness of beats up to very high numbers, and consider that up to high numbers beats of sensible intensity do not fail to be heard by reason of their number only. If this is the case the rapidity of beats must be of less importance in the theory of consonance than the law of dependance on intervals exhibited in the above quotation from Helmholtz.

To show the practical importance of this:—

(Pole, p. 213.) "Here we find the two fundamental notes themselves (c' – e') beating at the rate of 64 per second. . . . This is, therefore, a less perfect combination than the fifth; but still the beats are quick, and the effect is not disagreeable."

This seems to us incorrect. If the 64 fundamental beats per second were present with any intensity to speak of, the combination would certainly be most dissonant. It is because the ear receives the two notes on different parts of the sensorium, and so gets them out of each other's way, that the beats do not exist in sensible intensity, and do not produce dissonance.

In the appendix on Beats, and an essay there referred to, Dr. Pole has developed doctrines which arise to some extent from the point of view above indicated. The statement made is substantially that the beats described by Robert Smith ("Harmonics," 1749), have a real existence, besides the various types of beats described by Helmholtz.

Smith's cycles are best seen if the sum of two harmonic curves be described by Donkins's harmonograph, or some such machine. Smith's doctrine consists of the statement that the cycles which appear in the resulting curves are the cause of the beats. (Of course Smith did not use pendulum-vibrations, but the use of these adapts the doctrine to our modern knowledge.)

Now in order that these cycles may be seen, it is necessary that one and the same scribing point should describe the sum of the two motions simultaneously. If the motion be analysed and its two components be described separately on the paper, the cycles fail to appear.

This is what must happen in the ear if the doctrines of Helmholtz are even approximately true. The two sounds (if beyond the minor third apart) fall more or less completely on different parts of the sensorium, and the conditions requisite in the first instance for the formation of Smith's cycles are not fulfilled. Whether, if the cycles existed, the beats could arise out of them in the way in which we hear them, is quite a different question, on which we will not now enter.

The great importance of this question has induced us to prolong our remarks on it. On these points every student should consult Helmholtz's work. But on the more purely musical questions Dr. Pole's book has its own value.

OUR BOOK SHELF

A Treatise on Chemistry. By H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S., Professors of Chemistry in Owens College, Manchester. Volume II. Metals. Part II. (London: Macmillan and Co., 1879.)

THIS portion of Professors Roscoe and Schorlemmer's work treats of the metals of the iron, chromium, tin, antimony, and gold groups, also of spectrum analysis, the natural arrangement of the elementary bodies, and the condensation of the gases formerly called permanent. The treatment of these subjects is characterised by the same accuracy of description and clearness of explanation and arrangement that were so conspicuously displayed in the former parts, and the illustrations of metallurgical operations, &c., are well chosen and admirably executed, such, indeed, as are not to be found in any other English manual of chemistry. Amongst them may be especially noticed the figures of the plant for Weldon's method of regenerating manganese dioxide from chlorine residues, of the various forms of blast-furnace, of the Bessemer and Siemens-Martin processes for making steel, and of hydraulic gold-mining as practised in California. The best methods of detecting and estimating the several metals are carefully described, and interesting details are given relating to their history, some of which will, we think, be new to many readers.

Spectrum analysis, in which Prof. Roscoe is known to be a high authority, is well treated and illustrated, and attention is drawn to recent speculations, founded on spectroscopic observation, respecting the possible resolution of the bodies now regarded as elementary, into still simpler forms of matter. In the chapter on the Natural Arrangement of the Elements, a clear view is given of the remarkable relations between the properties of the elements and their atomic weights, first pointed out by Mr. Newlands, and further developed by Lothar-Meyer, and Mendelejeff; and the volume concludes with an account of the condensation of the gases formerly regarded as permanent, in which the ingenious forms of apparatus employed for the purpose by MM. Cailletet and Pictet are fully described and illustrated.

Altogether the two volumes of the work now published form a treatise on Inorganic Chemistry of which English science may well be proud; and the student who masters their contents will not fail to acquire a sound elementary knowledge of the subject. H. WATTS

Elementary Mechanics, including Hydrostatics and Pneumatics. By O. J. Lodge, D.Sc. Chambers's Elementary Science Manuals. (Edinburgh, 1879.)

THIS is one of the comparatively sound text-books which, since the publication of Thomson and Tait's work, have been every year more effectually thrusting aside the cumbrously artificial and often erroneous introductions to Physical Science which reigned almost unchallenged till about sixteen years ago. Dr. Lodge knows his subject well, and has evidently bestowed very careful thought upon it. Still we cannot unreservedly commend his book; and this for several reasons. First, he evidently proceeds under the idea that the subject can be made

easy to a beginner; that, in fact, there are no real difficulties which must be fairly faced by every student. We are surprised to find that this opinion can be held by any sound and successful teacher. Our own experience has always been dead against it. Dr. Lodge says of the elementary works of Thomson and Tait, Clerk-Maxwell, and Clifford, that they are "far too difficult for beginners." We do not think that his process of dilution makes the matter a whit less difficult. It has rather a tendency to conceal from the reader the place where the real difficulty lies, and a necessary difficulty *avoided* is certainly not *overcome*. Second, the avoidance of difficulties is managed by loose and sometimes even metaphysical language (see, for instance, pp. 83-5); evidently embodying some of the speculations in which the author has indulged while excogitating his work.

As an instance of loose writing take this (p. 16)

"5. The effects of force on matter are:
A. Change of motion, which is called *acceleration*.
B. Change of size or shape, which is called *strain* or deformation.

If only one force acts on a body, it must produce the effect A. If two or more forces act in different directions on a body, they must produce B, and they may produce A also." Now, at first sight, this looks well enough, and certainly Dr. Lodge knows the facts thoroughly. But how is *change of motion* called *acceleration?* Acceleration is correctly defined (p. 19) as *Rate* of change of *velocity*. But (p. 18) velocity is defined as "the rate of motion of a body." Put these extracts along with A above, and we find "change of that whose rate is called velocity is rate of change of velocity;" a very remarkable proposition, indeed one of high metaphysical interest. Again, if only one force act on a body, it *must* produce B unless the body be perfectly rigid. And two or more forces do *not* necessarily produce B, even on the most plastic body. Take the case of two different sets of parallel forces, for instance, each proportional to the mass of the element on which it acts.

In conclusion we may say that for the facts of elementary mechanics, for excellent examples of application of the formulæ, and such like matters, the student may use this work with profit:—but he ought to be warned that where the text appears most simple it is generally loose, often metaphysical, and here and there unintelligible.

Le conchiglie Pompeiane. Descritte dal Dott. Nicola Tiberi. 4to, 12 pp. (Napoli, 1879.)

THIS remarkable and well written memoir was published before the recent celebration at Pompeii of the eighteenth centenary of its destruction by a volcanic eruption of Vesuvius. It is the work of an excellent naturalist, who lives at Resina, close to the site of the ruined city, and who is especially conversant with the shells of the Mediterranean. The point of view to which he directs our attention is very different from that which has been taken by the geologist, antiquary, artist, or architect. He treats of the shells found in the ruins, and which had served for food, or been used by the Pompeians for ornament and other purposes. Indeed we know from Athenæus and other ancient authors that mollusca were then relished quite as much as they are at present by the inhabitants of Italy. I have been unable to discover in the loose and incorrect twaddle of the younger Pliny, who lost his life in the eruption, any mention of shells having been collected by his countrymen for the study of natural history. It is a pursuit or amusement of comparatively modern times. Dr. Tiberi gives a list of all the shells which he has noticed as Pompeian, belonging to no less than 44 species, with particulars of their relative abundance at Pompeii, as well as of their distribution and economy. Some were of eatable kinds, as the common oyster and mussel, *Pecten jacobæus*, *Venus chione*, *Tapes decussatus*, and several species of *Helix*. Others adorned fountains, as *Haliotis tuberculata*, *Murex trunculus*, and *M. brandaris*. The oriental pearl-shell (*Meleagrina margaritifera*) was represented only by a single valve. But the ladies of Pompeii seem to have attached considerable value to the *Cypræa* or Cowry, as amulets or charms to prevent sterility; and among these shells were some of species from the Red Sea and Persian Gulf. A single specimen of another exotic shell (*Conus textilis*) must have been kept for its great beauty as an object of curiosity. All the shells used in the ornamentation of fountains, five in the city and one in the suburbs, are of species which still are common in the Gulf of Naples; these shells are separately distinguished and named.

The memoir forms a short but interesting chapter of Roman history, and it tells us more than is generally known about the habits of the former masters of the world. J. GWYN JEFFREYS

Banka und Biliton. Von Dr. E. Reyer. (Vienna, 1879).

IN this pamphlet, originally published as an article in the *Oesterreichischen Zeitschrift für Berg- und Hüttenwesen*, the author has brought together a vast amount of useful information on these two important tin-yielding localities. At the present time, when the trade in this important but sparingly-distributed metal has been almost entirely diverted from its ancient centres in Cornwall and Saxony by the development of the sources of supply in the East Indies and Australia, the valuable details contained in this pamphlet cannot fail to be read with much interest. By far the largest and most reliable part of the information on these districts is inaccessible to most readers, from the fact of its being written in the Dutch language, and Dr. Reyer has done good service in bringing together so much material in a compendious and available form. The geological structure of the districts, the distribution of the ore in them, the methods of working, and the mineral statistics of the two areas, are very fully described, and the monograph concludes with an interesting sketch of the life of the Chinese immigrants who are engaged in working these tin ores in the Malay Archipelago.

J. W. J.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Greenwich Meteorological Observations

MR. BUCHAN (NATURE, vol. xx. p. 602) now admits that fundamental mean temperatures are to be found in Table 77. But his original unqualified remark (p. 526) was that mean temperatures for Greenwich "remain still to be calculated"; he even endeavoured to infer the mean annual temperature from the observations of the earth-thermometers, as though Table 77 (containing a value of this element with which no hitherto determined value for Greenwich can compete) had no existence. All this was likely to convey to an uninformed reader a very erroneous impression.

Table 52 contains simply a collection of the mean monthly results given in the twelve tables (38 to 49) referring to diurnal inequality, and as these numbers appeared to sufficiently well represent the varying temperatures of individual months, no account was taken of omitted days. But we can without difficulty determine their influence, usually small, in the months affected, and, in consequence of the now expressed want, shall probably take an opportunity of doing so. The question was of much greater importance as regards the fundamental values of Table 77, in forming which, as before mentioned, and as is